LIST OF ROCK SPECIMENS FROM KAPITI ISLAND.

(Numbers refer to specimens in the collection of minerals and rocks in the New Zealand Geological Survey.)

P.7623—Sheared greywacke from pug zone. Mouth of Waterfall Stream.
P.7624—Indurated greywacke-conglomerate boulder. Mouth of Waterfall Stream.
P.7625, P.7626—Indurated breccia of sandstone fragments in argillite matrix. Mouth of Waterfall Stream.
P.7627—Alternating black-and-grey argillite. 17 chains N.E. of mouth of Waterfall Stream.
P.7628—Weathered and sheared greywacke. 12 chains N.E. of mouth of Taepiro Stream.
P.7629—Massive indurated sandstone. 22 chains N.E. of mouth of Taepiro Stream.
P.7630—Sheared and slickensided argillite from pug zone. 27 chains N.E. of mouth of Tacpiro Stream.
P.7631—Indurated conglomerate; pebbles up to 1½ in, 32 chains N.E. of mouth of Taepiro Stream.
P.7632—Indurated sandstone. 44 chains N.E. of mouth of Taepiro Stream.
P.7633—Weathered phyllonite, coast. 13 chains S.E. of Boatshed.
P.7634—Fresh phyllonite, coast. 13 chains S.E. of Boatshed.
P.7635—Phyllonite, east side of Tahoramaurea Islet.
P.7636—Phyllonite, west side of Tahoramaurea Islet.

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PART II. PETROGRAPHY.

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SUMMARY.

AN EXAMINATION of five rock specimens from Kapiti Island has shown that the so-called schists are phyllonites that have been developed from normal quartzo-feldspathic grits, sandstones (the local greywackes), and argillites, by intense cataclastic metamorphism. These rocks are quite comparable with those that occur adjacent to zones of intense shearing, such as along the eastern border of the Livingstone Range intrusion (Hutton, 1940).

PETROGRAPHY.

Two of the specimens collected from outcrops opposite to Tokomapuna Island are similar to many greywackes, or indurated quartzo-feldspathic grits, occurring in the southern half of the Wellington Province. In particular, 7625 and 7629 are rather fine-grained types, composed in the main of quartz and feldspar, with which are associ-

* The study of Kapiti rocks was undertaken while the writer was on the staff of the University of Otago, New Zealand.

ated minor amounts of composite fragments and accessory minerals. The continuity of the rocks is frequently interrupted by narrow shear-zones along which occur films of pulverized minerals, carbonaceous pigment, and iron stain.

Quartz is generally angular, fractured, and it has very pronounced undulatory extinction. Often large grains of quartz have been broken into three or more portions, and subsequently the fragments have been drawn apart, the intervening areas being filled in with finely crystalloblastic material. These "stretched" grains are quite similar to those described and figured by many writers (Harker, 1932, p. 242, Fig. 115). In other instances shearing stresses have been sufficient to produce mortar-structure, or to cause complete granulation of quartz.

Feldspars occur as (1) uncommon, water-clear, and usually fractured, grains of albite (An_{3-9}), and (2) angular grains, often fractured or crushed, with numerous inclusions of prehnite, and (or) pumpellyite, or less frequently clinozoisite and sericite.

Ferromagnesian constituents are poorly represented, and biotite, though never plentiful, is the predominant coloured mineral. The mica forms ragged, twisted plates, that are usually slightly chloritized, and in the latter condition may have associated sericite; occasionally a marked bleaching, possibly baueritization, was noted. Clinopyroxene, rare and usually unaltered, is the only additional relict ferromagnesian found. Other relict constituents are twisted flakes of muscovite, fractured grains of sphene and zircon (unusually large zircon crystals occur in 7629), opaque ores, and deep greenish-yellow, strongly pleochroic, ferruginous epidote. Wisps and monomineralic pools of chlorite possibly represent completely reconstituted relict ferromagnesian minerals, and in some instances sphene is associated therewith. Fragments of argillite and argillaceous grit complete the assemblage. Fine-grained argillaceous grits (7626) are interbedded with the greywackes just discussed.

The schistose rocks have a decidedly phyllitic appearance with a sheen on the prominent *s*-surfaces, and narrow lenses and schlieren of quartz and feldspar suggest incipient development of foliation. In hand-specimen, therefore, these rocks are in some respects similar to the quartz-feldspathic schists of the Chl. 2–3 subzones of Marlborough and Otago. A study of the thin sections, however, tells a very different story. The rocks have a distinct porphyroclastic structure and consist of a mosaic of pulverized quartz and feldspar with pronounced preferred orientation; the individual grains average about 8 microns in diameter. Intimately associated with the quartzo-feldspathic material are the products of neomineralization—sericite, prehnite, pumpellyite and clinozoisite, with the last two minerals rare. The undestroyed remnants scattered throughout the fine-grained groundmass are usually augen of quartz showing every gradation from extreme undulatory extinction to fractured and "stretched" grains embedded in their own finely crushed material. Original incompetent pelitic fragments have been largely destroyed and now form dusty, and often semi-opaque clouds of carbonaceous material and iron ore. In a section cut perpendicular to the plane of fissility, augen of minute grains of quartz, feldspar, and a few unreduced

relicts, are found lying in a groundmass of pulverized material, interrupted by numerous sub-parallel shear surfaces.

Occasional unbroken crystals of pistachio-green tourmaline were noted, and in one instance such a crystal was oriented with its longer axis perpendicular to the direction of shear.

Megascopically these fissile rocks are very similar to those that make up the mylonitic band, approximately 300 yards in width, forming the eastern boundary of the Livingstone Range ultrabasic sill in Southland. Without doubt the latter rocks have resulted from intense deformation of typical Chl. 1 subzone greywackes, sandstones, etc., and as such, represent the sole of movement along which the basic and ultrabasic intrusion was thrust into place.

Conclusions: Careful examination of the schistose rocks and comparison with similar examples leaves little doubt in the writer's mind that they are the products of intense cataclasis of quartzo-feldspathic grits and sandstones of types such as 7625 and 7629, and as such should be classified as phyllite-mylonites or phyllonites, as defined by E. B. Knopf (1931). The strong preferred orientation (Fig. 6) of the quartzes in the individual augen, the lenticular struc-

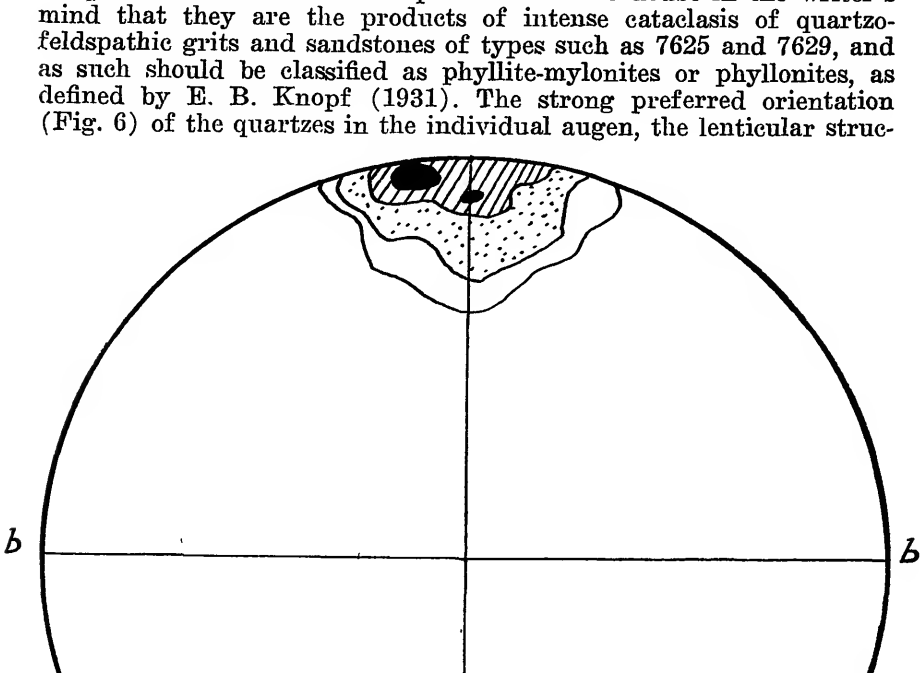

FIG. 6—180° poles of quartz axes in quartz augen of phyllonites. Maximum concentration 16%; contours 14, 12, 8.

ture, and the pronounced phyllitic appearance of the rocks fully supports this opinion. Although there is some superficial resemblance to schists of subzone Ch. 2–3, it should be remembered that (1) the megascopic lenticular character is not due to incipient foliation, but to the milling and rolling out of augen of quartz and feldspar under conditions of very severe stress and (2) schists rightly belonging to subzone Chl. 3 are always dominantly crystalloblastic, whereas the Kapiti Island phyllonites are almost entirely cataclastic.

In common with a wide range of greywackes from Wellington Province, the percentage of hydrated calcium aluminium silicates associated with the feldspars in the non-mylonitic rocks is decidedly less than is found in the more normal greywackes containing plagioclases of intermediate composition. This leads one to conclude that the original plagioclases, now indeterminable in most instances, were rather albitic in composition—possibly no more calcic than oligoclase. If the writer's interpretation of the origin of monomineralic pools of sericite is correct, then potash feldspar was not a rare constituent. It is suggested then that, in common with a great many greywackes found in the Wellington provincial area, the Kapiti Island quartz-feldspathic sandstones have been derived from an area in which granitic types were plentiful and not basic to intermediate volcanic rocks. Additional support for this suggestion is given by the following data:

(1) The frequency of occurrence of biotite, often the sole relict ferromagnesian constituent.

(2) The heavy-mineral assemblages from many Wellington greywackes show zircon to be the most abundant constituent, and frequent associates therewith are spessartite-almandine, and apatite. Zircon and almandine are not generally associated with basic or intermediate volcanic rocks, but are characteristic accessory constituents of granitic rocks.

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